

INTERACTION BETWEEN HOST –PLANT AND FORMICIDAE IN THE CENTRALE MITIDJA (ALGERIA)

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ABSTRACT

The study of the Formicidae settlement is realized thanks to the squares technique in the technical institute of fruit arboriculture and vine from which we chose two orchards one is a vineyard, the other one an apricot- tree orchard and a fallow land. These three study environment are situated in Béni-Tamou in the heart of the central Mitidja. Our results have permitted to collect 1112 individuals from which 15 species, 12 kinds and 3 subfamilies. The most abundant species are *Tapinoma nigerrimum*, *Messor barbarus*, *Aphenogaster testaceo-pilosa* and *Cataglyphis viatica* on the vine and the fallow land and their frequencies of occurrences are signalled between Omnipresent for *Messor barbarus*, constant and regular for *Tapinoma nigerrimum*, *Cataglyphis viatica* and *Monomorium salomonis*. As for the apricot tree we notice a low constancy of Formicidae from which a group of accessory species are composed of *Tapinoma nigerrimum*, *Cataglyphis viatica*, *Monomorium salomonis* and *Crematogaster scutellaris*. The equitability index has shown a perfect balance between the species on the three study environment.

KEYWORDS: Formicidae, Central Mitidja, Apricot, Vine, Fallow, Inventory

INTRODUCTION

Small and abundant, ants have attracted the attention of several researchers since the ancient century. Being a social insect; their settlement reaches a particular level of sociality. All over the world, many studies have been led on the Formicidae family, especially on their bio ecology and their systematic. Since the end of the nineties 1990, inventories of the myrmecofauna have multiplied, more often in the form part of projects aiming at reaching a better knowledge of the biodiversity. They are predators which regulate the populations of many other insects, and at the same time scavengers which make the insects cadavers or small animals disappear, pollinators and essential agents in the dispersion of seeds and the enrichment of soils (WILSON,1987; TOPIN,1994; ANDERSENET *al*, 2000; FLOREN and *al*, 2002; RETANA, 2004 cités par DJIOUA, 2010. Based on a great number of criterion CAGNIANT (1970) was able to distinguish eight subfamilies which are: Ponerinae, Ceraphilinae, Dorylinae, Leptanilinae, Promyrmicinae, Myrmicinae, Dolichoderinae and Formicinae. But the most represented in nature are: the Ponerinae, the myrmicinae, the Dolichoderinae, and Formicinae who are characterized by differences at the level of petiole and post- petiole segments (BELKADI, 1990).

In those animals, it exists in fact, in the same colony, individuals which aspect is radically different, both in size and shape. This polymorphism prohibits any general description based on a single sample taken as morphologic type, since there are several castes constituting so many different categories that must be defined first (CAGNIANT, 1972). Many authors all over the world have focused their study on ants, most of them interested in their bio ecology.

In Europe we mention the works of BERNARD (1951, 1958, 1968, 1983), the works of GASPAR (1972) in Belgium; JOLIVET (1986) in France; HÖLLDOBLER et WILSON (1996); BERNADOU et *al.* (2006) et TOFFIN (2010). in Algeria, most of the works are realised in a natural environment in different regions, we mention the works of CAGNANT (1966, 1968, 1969, 1970, 1973); DOUMANDJI (1986); BELKADI(1990) in the Kabylie region; DEHINA (2004) in Algiers Sahel; BOUZEKRI (2008, 2010) (in the highlands of Djelfa); AMARA(2010) in Laghouat and finally CHEMALA (2010) in the sahara (Ouargala). This work completes works already realised. It aims at observing the distribution of ants species compared with the nature of culture environments.

MATERIALS AND METHODS

The work area is located in the central part of the Mitidja 13 km far from the country of Blida, it is bordered from the south by Blida (**36° 30' North and 2° 50' East**) and the first slopes of the Metidjian Atlas, to the north by citrus and medlar orchards of Boufarik) (**36° 35' North and 2° 59' East**) in the east by Oued Chiffa (**36°31'North and 2°44' East**) and in the North-East by the mountains of Soumaâ (**36°28'North and 2°58'East**) (Figure 1). exactly, at the farm of demonstration and fruit arboriculture of Béni-Tamou (I.T.A.F.V)where this study was realised and which extends over about **102 ha**, it has several orchards intended mainly for the production of rootstocks and scions and incidental fruit. The orchards are protected by mixed windbreaks belonging to the kinds: *Tamarix* sp. *Ceratonia siliqua*, *Olea europea* and *Casuarina* sp. As for the soil, the rate of organic substance is of, **2.63%**, and the PH **7.78**. The soil is od sandy clay and loam nature. The levels of potassium and of phosphor are respectively of **45** et **69.83 ppm** (ANONYME, 2007). It is found in bioclimatic sub-humid stage of temperate winter. With an annual average of precipitations of **812.2mm**. The coldest month is January with an average temperature of **12.1°C**. And the hottest month is august with an average temperature of **30.4°C**.

We have applied a squares or quadrates method, it corresponds to a quantitative technique, this one provides an image on the density of the different ants species on a given surface. We collect the sample on the soil of the three milieus: on two orchards the first one is a vine, the le second one is an apricot-tree. The third milieu is a fallow. On the collecting boxes, we mention the date and the milieu. The frequency of the sorties is of one sortie per month on which (14) samplings for all, on a surface of 1 to 1.5ha for the orchards of 2 to 3ha for the fallow (Figure 2).We have adopted the qualitative technique that allows to obtain an idea of the fauna populating a determined milieu, their selectivity towards the species is generally important and requires to correctly interpret the obtained results the use of a quite simple process (observations, partial exploration of the soil ...) which allowed to realize settlement's studies based on species inventory and their spatial repartition depending on the milieus. The samples are brought to the laboratory of agricultural zoology of the National Higher agricultural school of El-Harrach, under the direction of of the Professor S. Doumandji and Miss F. Marniche Lecturer in the National Higher Veterinary and agricultural school of El-Harrach, Algiers to be counted and identified.

RESULTS

Our study which consisted in gathering ants samples using the squares or quadrates method, has shown the existence of 10 ants species at the level of the vineyard; 9 species at the level of the apricot trees orchard and 12 species at the level of the fallow, see Table 1, Table 2 and Table 3. In total 15 ants species have been listed from which 10 kinds and 3 sub families. Among them the Dolichoderinae which are the most represented at the level of the vineyard and the fallow with respectively 55 % and 61 %. Whereas the Formicinae are the less found in the three milieus, 10 % for the two vine

orchard and apricot- tree and, 11 % in the fallow land (Figure 3, Figure 4 and Figure 5).

As for the relative abundance of ants species, the results show that the species *Messor barbara* was present in the three milieus with 19.58 % (112 individuals) in the fallow, 11.82 % (61 individuals) in the vineyard and a lower rate in the apricot- trees orchard 9.35 % (13 individuals). *Tapinoma nigerrimum* is more abundant in the fallow with 46.5 % which corresponds to 266 individuals; 21.58 %. In the apricot-trees orchard only 15.7 % in the vineyard, in parallel a same kind of species *Tapinoma* sp. is noticed in the vineyard with 39.15 % (202) individuals. For *Aphenogaster testaceo-pilosa*, this species doesn't make a distinction between vineyard and fallow with respectively 10.85 % and 12.41 %. *Monomorium salomonis*, *Pheidole pallidula*, *Crematogaster scutellaris* according to the results they prefer the apricot-trees orchard as we have noticed them in this milieu with 20.14 %; 24.46 % and 14.39 % respectively. The rare species are: *Lasius* sp. Rencotrée in the apricot trees orchard inside the ripe apricots, *Messor sanctus* and *Camponotus barbaricus xanthomelas* only seen in the fallow, *Aphenogaster depilis* found in the three milieus. The most frequent species are ranging between Omnipresent, regular and constant which rates are superior to 55% are *Messor barbara* omnipresent in the vineyard, identified on each harvesting. *Tapinoma nigerrimum*, *Messor barbara*, *Cataglyphis viatica* their rates are superior to 75 % in the fallow, they are considered constant. The regular species are *Tapinoma nigerrimum*, *Aphenogaster testaceo-pilosa*, *Cataglyphis viatica* on the vine. *Aphenogaster testaceo-pilosa* and *Monomorium salomonis* in the fallow. The accessory species only identified on the apricot- trees orchard are: *Tapinoma nigerrimum*, *Monomorium salomonis*, *Cataglyphis viatica* and *Crematogaster scutellaris*. For the majority of the accidental species they are whether absent or rarely represented, we can mention *Tapinoma* sp, *Messor* sp, *Aphenogaster depilis*, *Pheidole pallidula*, *Tetramorium semeleave*, *Tetramorium biskrense*, *Crematogaster scutellaris*. Other species change their categories depending on the milieu such as, *Monomorium salomonis* accidental on the vine, accessory on the apricot-tree and regular on the fallow, *Cataglyphis viatica* regular on the vine, accessory on the apricot-tree, and constant on the fallow. *Crematogaster scutellaris* accidental on the vine and accessory on the apricot.

The amplitude of the diversity of ants species depending on the milieus is very important having to the high values of their diversity index of shannon-waever which oscillates between 2.34 bits and 2.63bits, these values are high. Whereas the equitability is near one (1) with 0.79, 0.82 and 0.65 on the vine, respectively on the apricot and the fallow, consequently the species are in equilibrium with each other (Table 6).

DISCUSSIONS

During fourteen months (14) of study, we have gathered 1112 ants individuals belonging to 15 species, shared out between 3 sub- families: Ponerhinae, Formicinae and myrmicinae. The same species kinds are registered by BOUKEROUI (2006) and MEZIOU-CHEBOUTI (2010) in a Pistachio-tree orchard (*Pistacia vera*) in the same area of Béni-Tamou. Regarding those authors, they didn't mention the presence of the following species : *Tetramorium semeleave*, *Tapinoma nigerrimum*, *Lasius* sp, *Aphenogaster depilis* and *Messor sanctus*. The most abundant species is *Tapinoma* in the vineyard where it's regular, its number reaches 283 with 81 individual of *Tapinoma nigerrimum*, the sum of both relative abundance rates for these species reach 54.85 %. In the fallow it is considered constant where its frequency cannot be neglected 46.5%. Whereas, *Tapinoma nigerrimum* is accessory and less signalled in the apricot-tree orchard with 21.58 %. According to CAGNIANT (1973) *Tapinoma* is related to the human agricultural activities (anthrophophile) and it is found in the pasturages of humid milieus to 1800 m (CAGNIANT, 1968). For the species of *Messor barbarus*, *Aphenogaster testaceo-pilosa* and *Cataglyphis viatica* they are represented relative abundance rates respectively 11.85 %, 10.85 % and

10.08 % on the vine. On the fallow we have noticed 19.58 % for *Messor barbarus*, this species according to CAGNIANT (1968) is nonexistent in abound forests, abound plains and plateaus. 12.4. % registered for *Aphaenogaster testaceo-pilosa* and 8.39 % for *Cataglyphis viatica*. *Messor barbarus* and *Cataglyphis viatica* are poorly represented in the apricot-trees orchard with percentages ranges from 9.35 % to 7.91 %. Whereas *Aphaenogaster testaceo-pilosa* is absent. According to BERNARD (1959) the *Aphenogaster* and the *Messor* are xenophile, whereas those which are more sensible to summer temperatures and witch tolerate humid lands are *Pheidole pallidula* and *Aphenogaster depilis*. CAGNIANT (1973) declares that the kind *Messor*, *Camponotus*, *Tapinoma*, *Pheidole* and *Lasius* are sedentary insects. The relative abundance of ants species captured in the three study milieus has shown the preponderance of the kind *Tapinoma* in the fallow and the vine, this kind known in cultivated milieus, their nests are the most colonizers of the plants, these specimens climb the stalks up and down at all times. According to CAGNIANT (1966) *Tapinoma nigerrimum* is an anthropophile species that is found everywhere in the pasturage, the reforestation and the courses, it nidifies its nests around the plants which the relations (aphis -ant) or (cochineal -ant) can settle, and marked by the presence of exudates. This same author (1973) defines it as a sedentary insect. *Tapinoma nigerrimum*, *Pheidole pallidula*, *Monomorium salomonis* and *Crematogaster scutellaris* seem to prefer the apricot orchard where the rates vary between 14.4% and 24.5%. The frequency of occurrence has shown the existence of four species, *Messor barbarus*, *Cataglyphis viatica*, *Tapinoma nigerrimum* and *Aphaenogaster testaceo-pilosa* which are between constant and regular their frequencies vary between 54 and 95% on both milieus fallow and vine. However, on this last orchard we have noticed the omnipresence of *Messor barbarus*. D'après CAGNIANT (1966), this last species is of Maghreb Mediterranean origin, it prefers dry, rocky soils, with a small slope at the level of a sparse vegetation and to abrit from the winds. The apricot orchard despite its low richness in myrmecofauna only 139 individuals, it seems to host only accessory species such as: *Tapinoma nigerrimum*, *Cataglyphis viatica*, *Monomorium salomonis* and *Crematogaster scutellaris*. We can notice that *Crematogaster scutellaris* is a lignicole ant, we have found it on the trunk of the apricot, the most of them are dead. It is present on the Mediterranean perimeter. It lives in low humidity nests, generally in wood, this kind shows a great ecological success being able to cope with all types of milieus and their floristic availability stated by CAGNIANT (1968).

JOLIVET (1986) cites a case of *Acacia* in Africa which gives shelter to *Crematogaster* in exchange of an effective cleaning, elephants and giraffes. TOFFIN (2010) confirm a selection of host -plants by arboreal ants is related to the recognition then the discrimination of the chemical substances produced by plants. The preference for a vegetal essence is related to two factors, one is genetically determined therefore inheritable and the other one precociously acquired under the form of a print during a pre- imaginal learning. According to Cagniant (1968) the floristic composition and physiognomy of the vegetal coverage has an important influence on the myrmecofauna of a given milieu. The manipulation of mosaics represents a mean of an integrated fight against the cultures ravagers. In those places, the myrmecofauna forms a dynamic system which composition and structure vary in time and space partially depending on the structure and the specific composition of the vegetation.

CONCLUSIONS

Several works of entomologists realized on the interaction of the myrmecofauna and their host plants have shown a strong relation between those two partners. The simultaneous coevolution by mutual actions of plants and ants must have been achieved on millions of years and probably due to the appearance of ants. Consequently the myrmecophism produces an association with mutual benefices. It is certain that the myrmecophytes really nourish the ants or provide them shelter

and food.

Manual collecting used for the realisation of an inventory of Formicidae in 3 different milieus: a vine yard, an apricot orchard and a fallow land, in the technical institute of fruit arboriculture of Béni-Tamou in Blida county, has allowed to define a specific richness for all the milieus (equal to 15 species belonging to 12 kinds and 3 sub-families. The three sub-families registered are the Myrmicinae, followed by the Formicinae and finally the Dolichoderinae. In terms of species the Myrmicinae are *Messor barbarus*, *Messor sanctus*, *Messor* sp, *Aphenogaster testaceo-pilosa*, *Aphaenogaster depilis*, *Crematogaster scutellaris*, *Tetramorium biskrensis*, *Tetramorium semeleave*, *Pheidole pallidula* and *Monomorium salomonis*. The Formicinae are represented with the *Cataglyphis viatica*, *Camponotus barbaricus*, *xanthomelas* and *Lasius* sp whereas the sub family of Dolichoderinae is represented by one kind and two species *Tapinoma nigerrimum* and *Tapinoma* sp.

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APPENDICES

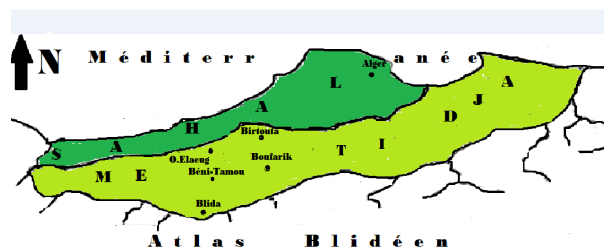


Figure 1: Geographic Location of the Area of Béni-Tamou in the Mitidja (MUTIN, 1977 Amended)



Figure 2: Parcelled Plan of the Demonstration Farm of Béni-Tamou (Echelle: 1/30.000)

Table 1: Total Specific Richness of Formicidae Gathered in the Vineyard

Sub-Family	Total Richness (S)	Formicid Species
Myrmicinae	7	- <i>A phenogaster depilis</i> (Lucas.1849)
		- <i>Aphenogaster testaceo-pilosa</i> (Lucas,1849)
		- <i>Crematogaster scutellaris</i> (Olivier, 1792)
		- <i>Pheidole pallidula</i> (Nylander, 1848)
		- <i>Messor Barbara</i> (Linné, 1767)
		- <i>Messor.sp</i>
		- <i>Monomorium salomonis</i> (Linné,1758)
Formicinae	1	- <i>Cataglyphis viatica</i> (Fabricius,1793)
Dolichoderinae	2	- <i>Tapinoma nigerrimum</i> (Nylander,1788)
		- <i>Tapinoma sp</i>

S: Specific Richness

Table 2: Total Specific Richness of Formicidae Gathered in the Apricot Orchard

Sub-Family	Total Richness (S)	Formicid Spices
Myrmicinae	6	- <i>A phenogaster depilis</i> (Lucas.1849)
		- <i>Crematogaster scutellaris</i> (Olivier,1792)
		- <i>Pheidole pallidula</i> (Nylander, 1848)
		- <i>Messor Barbara</i> (Linné, 1767)
		- <i>Tetramorium semelaeve</i> (Forel,1904)
		- <i>Monomorium salomonis</i> (Linné,1758)
Formicinae	2	- <i>Lasius</i> sp. - <i>Cataglyphis viatica</i> (Fabricius,1793)
Dolichoderinae	1	- <i>Tapinoma nigerrimum</i> (Nylander,1788)

S:Specific Richness

Table 3: Total Specific Richness of Formicidae Gathered in the Fallow

Sub-Family	Total Richness (S)	Formicid Spices
Myrmicinae	8	- <i>A phenogaster depilis</i> (Lucas.1849)
		- <i>A phenogaster testaceolilosa</i>
		- <i>Pheidole pallidula</i> (Nylander, 1848)
		- <i>Messor Barbara</i> (Linné, 1767)
		- <i>Messor</i> sp.
		- <i>Messor sanctus</i>
		- <i>Tetramorium biskrensis</i> (Forel,1904)
		- <i>Monomorium salomonis</i> (Linné,1758)
S :Specific Richness Formicinae	2	<i>Cataglyphis viatica</i> (Fabricius,1793) - <i>Camponotus barbaricus xanthomelas</i> (Emerys, 1905)
Dolichoderinae	2	- <i>Tapinoma nigerrimum</i> (Nylander,1788)
		- <i>Tapinoma</i> sp

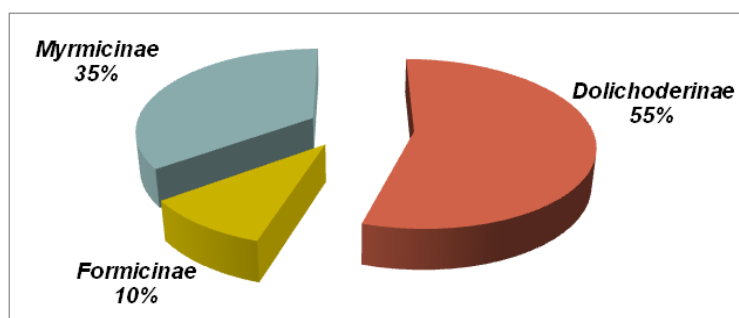


Figure 3: Distribution of the Sub-families Formicidae in the Vineyard

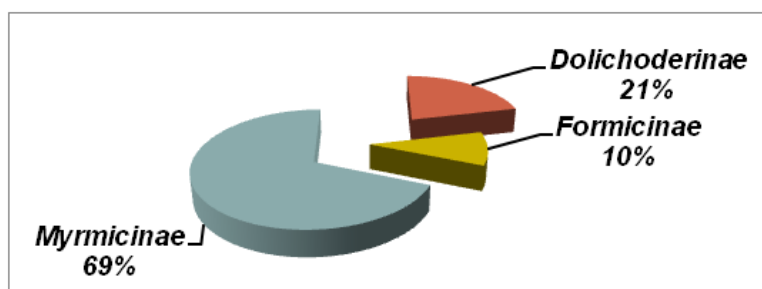


Figure 4: Distribution of the Sub-families Formicidae in the Apricot Orchard

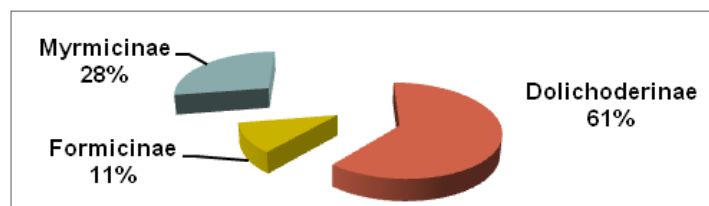


Figure 5: Distribution of the Sub-families Formicidae in the Fallow

Table 4: Relative Abundances (AR %) or Centesimal Frequency of Formicidés Gathered on the Three Study Stations 2013/2014

Formicidae Species	Vine		Apricot		Fallow	
	i. n.	R. A..%	i. n.	R. A. %	i..n.	R. A. %
<i>Messor barbara</i>	61	11,82	13	9,35	112	19,58
<i>Messor sanctus</i>	-	-	-	-	1	0,17
<i>Messor sp.</i>	5	0,97	-	-	18	3,15
<i>Tapinoma nigerrimum</i> ,	81	15,7	30	21,58	266	46,5
Table 4 : Contd.,						
<i>Tapinoma sp.</i>	202	39,15	-	-	20	3,5
<i>Aphenogaster testaceopilosa</i>	56	10,85	-	-	71	12,41
<i>Aphenogaster depilis</i> ,	8	1,55	1	0,72	1	0,17
<i>Cataglyphis viatica</i>	52	10,08	11	7,91	48	8,39
<i>Monomorium salomonis</i>	25	4,84	28	20,14	19	3,32
<i>Pheidole pallidula</i>	11	2,13	34	24,46	1	0,17
<i>Crematogaster scutellaris</i>	15	2,91	20	14,39	-	-
<i>Tetramorium semeleave</i>	-	-	1	0,72	-	-
<i>Tetramorium biskrensis</i>	-	-	-	-	13	2,27
<i>Camponotus, barbaricus xanthomelas</i>	-	-	-	-	2	0,35
<i>Lasius sp.</i>	-	-	1	0,72	-	-
Number of Individuals	516		139		460	

i. n: individuals number of specie; R. A..%: Relative abundances in percentage;-: Absence of species

Table 5: Frequency of Occurrence (O. F%) of the Myrmecofauna of the Three Study Parcels

Formicidae Species	Vine			Abricot			Fallow		
	i.n	F.O%	Catégorie	ni	F.O%	Catégorie	ni	F.O%	Catégorie
<i>Tapinoma nigerrimum</i> ,	8	57,14	Regular	5	35,71	Accessory	13	92,86	Constant
<i>Tapinoma sp.</i>	2	14,28	Accidental	-	-		1	7,14	Accidental
<i>Messor barbara</i>	14	100	omnipresent	3	21,43	Accidental	13	92,86	Constant
<i>Messor sp.</i>	3	21,43	Accidentelle	-	-		2	14,28	Accidental
<i>Aphenogaster testaceopilosa</i> ,	8	57,14	Regular	-	-	-	10	71,43	Regular
<i>Aphenogaster depilis</i>	3	21,43	Accidental	1	7,14	Accidental	1	7,14	Accidental
<i>Pheidole pallidula</i>	2	14,28	Accidental	3	21,43	Accidental	1	7,14	Accidental
<i>Cataglyphis viatica</i>	10	71,43	Regular +	4	28,57	Accessory	11	78,57	Constant
<i>Monomorium salomonis</i>	1	7,14	Accidental	4	28,57	Accessory	8	57,14	Regular
<i>Tetramorium biskrensis</i>	-	-		-	-	Accidental	2	14,28	Accidental
<i>Tetramorium semeleave</i>	-	-		1	7,14	Accidental	0		
<i>Camponotus barbaricus xantholelas</i>	-	-		-	-		1	7,14	Accidental
<i>Messor sanctus</i>	-	-		-	-		1	7,14	Accidental

Table 5: Cond.,

Crematogaster scutellaris	2	14,28	Accidental	5	35,71	Accessory	-	-	
Lasius sp.	-	-		1	7.14	Accidental	-	-	-

i. n: individuals number of specie; **F.O%:** Frequency of occurrence; **-:** *Absence of species*

Table 6: Diversity Index of Shannon Weaver

Parameters	Vine	Apricot	Fallow
H'(bits)	2,63	2,6	2,34
Hmax(bits)	3,32	3,17	3,58
E	0,79	0,82	0,65

H': Diversity Index of Shannon-Weaver; **max:** Maximal index; **E:** Equitability

